5 Developing a Concept of Operations for a Regional Project

The previous chapter noted that, while the structure/components of a Concept of Operations is the same for all systems, the content of a Concept of Operations for a regional system encompasses more complex interactions and inter-relationships due to the very nature of these integration initiatives. The necessity to produce a comprehensive document that addresses this degree of complexity has significant implications for the strategy utilized to develop the Concept of Operations. The purpose of this chapter is to identify development issues that are critical to the creation of a Concept of Operations for a regional initiative, and to address these issues with advice based on interviews with transportation professionals and with best practices from regional examples.

5.1 CHAPTER OVERVIEW

The purpose of this chapter is to provide guidance to support the development of a Concept of Operations document for a regional integration project. The key objectives of this chapter are:

- To address critical issues related to Concept of Operations development, including stakeholders, institutional barriers, resources, and performance measures
- To provide specific guidance on how to develop core elements.

5.1.1 Relationship to Previous Chapter

Chapter 4 defines the Concept of Operations in the context of a regional integration initiative: it explains the goals and objectives and defines the individual core elements of a Concept of Operations, using regional examples. This chapter provides guidance for *developing* a Concept of Operations for an integrated system, including advice for beginning the process, identification and involvement of stakeholders, and developing each of the individual core elements.

5.1.2 Chapter Sections:

- Initiation of the Process
  - Assembling the Writing Team
  - Required Resources
- Stakeholder Identification and Involvement
  - Institutional Barriers

  - Developing Performance Measures

- Developing the Elements
- Chapter Summary
- Specific Literature Supporting This Chapter

5.2 INITIATION OF THE PROCESS

5.2.1 Assembling the Writing Team

The development of any Concept of Operations is an iterative process, but the first order of business is to assemble a writing team. The writing team is the core group of individuals responsible for working with stakeholders to pull together all of the information required in a Concept of Operations. The method used to recruit the team and the composition of the team should be based on the nature of the identified regional need. It makes sense to include persons who were involved with the needs assessment/planning process *if they are appropriate for the writing team*; if they are not, they may nevertheless be appropriate for the stakeholder list as the development task evolves. The writing team should be composed of those persons who will be immediate users of the system, and who have the time, energy, and *regional* commitment. It is important for a team that is developing a Concept of Operations for a regional initiative to be composed of individuals from a variety of backgrounds, who represent the core of regional stakeholders. Its composition should be a balance of technical and non-technical individuals who reflect:

- The types of organizations involved in the integration (e.g., planning organizations, transportation agencies, emergency services, transit, private partners).
- The jurisdictional/geographic scope.
- The levels of technical expertise needed.
- Identified "champions" for the system who might not fit into the above categories.

The writing team will develop a concept based upon the identified regional need. It will then bring in more stakeholders from the region to refine and solidify the initial concept.

5.2.2 Required Resources

Demand for resources is driven by the scope and complexity of the proposed regional system. This section will address important issues to be considered in identifying and defining those resources.

The scope of a project will greatly affect the staff time and funds that are necessary for completing a Concept of Operations. A regional integration project can expect to require a significant budget and staff involvement. Staff involvement may be mitigated somewhat by the hiring of consultants for the writing task. However, user/stakeholder involvement will still be required for input, monitoring, and management of the process. One advantage of consultants is that they may be seen as "neutral" by stakeholders who fear that a lead organization may be using the process to promote its own narrow interests. In this sense, consultants may help de-politicize the process and may be better able to address institutional barriers. A disadvantage of consultants is that they may lack the regional commitment and perspective of a lead agency or well-assembled writing team. After all, consultants will not likely be major users of the system.

A key resource for Concept of Operations development is existing transportation-related documents, especially those pertinent to a regional/integrated system. There will likely be many of these to choose from given the number of systems, the existence of regional planning, and the previous build-out of projects in the constituent systems. The types of documents used will vary with the system, but examples of the kinds of documents that might be useful are listed below:

- Development and Preparation Guides for Concept of Operations Documents – This would include our companion document *Developing and Using a Concept of Operations in Transportation Management Systems Handbook* and *the Guide for the Preparation of Operational Concept Documents* (ANSI/AIAA G-043-1992), as well as documents that describe other phases of the systems engineering process.

- Regional ITS Architecture – This valuable resource provides the general framework for the planning and deployment of ITS for a region.

- Regional Concept for Transportation Operations (RCTO) – This management tool is a product of Regional Transportation Operations Collaboration and Coordination (RTOCC), a process, related to Regional ITS Architecture, which seeks to link planning and operations. A RCTO outlines 2 – 5 year transportation operations objectives for a region.

- Other regional planning documents, such as Early Deployment Plans, Strategic Planning, and Business Planning documents.

- Existing Concepts of Operations and Functional Requirements documents – Concepts of Operations from constituent systems will inform, and be eventually be informed by, the more comprehensive regional document.

- Concepts of Operations and Functional Requirements of integration projects, from other regions, that are similar to the project under consideration.

It is important also to document these resources in the Concept of Operations. Figure 5.1 presents an excerpt from Next Generation 9-1-1 System Preliminary Concept of Operations.

The *Next Generation 9-1-1 Initiative* is a DOT research and development project with a multistate (nationwide) scope. It is a good example of the kinds of documents needed to develop a Concept of Operations for a regional project.

Regional Example

Next Generation 9-1-1 System

Preliminary Concept of Operations

6 Source References

Primary sources of information used in this document were published and working draft documents from the Federal Communications Commission, National Emergency Number Association, the Internet Engineering Task Force (IETF), and the Alliance for Telecommunications Industry Solutions (ATIS) Emergency Services Interconnection Forum (ESIF).

- *Network Architecture Properties in 2010, Extending E9-1-1 to Satellites, and Generic Architectures to Support Video and Advanced Services;* Network Reliability and Interoperability Council (NRIC) VII Focus Group 1B, Federal Communications Commission (FCC); June, 2005. *Long Term Issues for Emergency/E9-1-1 Services*; (Draft). – These documents are designed to provide a set of specific recommendations regarding future emergency communications network properties, and their capability by 2010 to support the exchange of voice, data, text, photographs and live video through the emergency services internetwork to the PSAP and beyond.

- *Communication Issues for Emergency Communications Beyond E911: Report #1, Properties and Network Architectures That Communications Between PSAPS ad Emergency Services Personnel Must Meet in the Near Future.* NRIC VII Focus Group 1D, FCC. December 2004. – *Communication Issues for Emergency Communications Beyond E911: Final Report - Properties and network architectures for communications between PSAPs and emergency services organizations and personnel.* The purpose of these documents is to describe the properties that network architectures for communications between PSAPs and emergency services personnel must meet.

- *Draft i3 Requirements.* National Emergency Number Association (NENA) VoIP Technical Committee Long Term Definition Working Group. September 2005. This document provides requirements for a NENA-recommended standard for the i3 architecture for end-to-end emergency calling over IP-networks.

- *Requirements for Emergency Context Resolution with Internet Technologies.* Internet Engineering Task Force. October 2005. http://www.ietf.org/internet-drafts/draft-ietf-ecrit-requirements-01.txt - This document enumerates requirements for emergency calls placed by the public using voice-over-IP (VoIP) and general Internet multimedia systems, where Internet protocols are used end-to-end.

- The ATIS-ESIF Emergency Services Network Interfaces Task Force 34 will define a new messaging and interaction protocol between PSAPs and Emergency Services Networks that goes significantly beyond the paradigms that exist to provide those services today. Various summaries and briefing materials are available at the Task Force 34 website at http://www.atis.org/esif/esmi.asp. The Task Force 34 messaging and interaction protocol will be specified as an American National Standard (ANS).

This outline follows the guidance in the recent Federal Highway Administration (FHWA) pooled fund study, *Developing and Using a Concept of Operations in Transportation Management Systems*,[2] which is based on the ANSI/AIAA standard, *Guide for the Preparation of Operational Concept Documents*.[3] The Concept of Operations is the first step in the systems engineering process promoted by FHWA (see Figure 1-1). The concept of operations describes broad goals, user needs, and the operating environment. It forms the basis for developing system requirements. Note: common usage in systems engineering has the terms "Concept of Operations Document" and "Operational Concept Document" as interchangeable terms.

Figure 5.1- Next Generation 9-1-1 System Preliminary Concept of Operations

This figure is an excerpt from Section 6 Source References of the Preliminary Concept of Operations, which provides a list and brief description of the documents used in developing this Concept of Operations. An additional excerpt in the figure from Section 1 identifies another source document.

5.3 STAKEHOLDER IDENTIFICATION AND INVOLEMENT

Developing a Concept of Operations for a regional project will require particularly intense stakeholder participation. Engaged stakeholders are critical for both input and support. For a regional integration project especially, stakeholder involvement is crucial in addressing two key areas:

- Institutional Barriers
- Performance Measures

5.3.1 Institutional Barriers

Although integrating systems can present a considerable technical challenge, many transportation professionals that have been involved in such undertakings have stated that the greatest challenge lies in evolving a strategy to deal with institutional barriers.

For any regional integration effort to be successful, the constituent organizations will need to coordinate operations and share information. The details of this sharing and coordination will need to be worked out. This can be a difficult and time-consuming process and, inevitably institutional barriers will need to be confronted. This issue was addressed in a Integrated Transportation Management Systems (ITMS) Conference White Paper (Louis Neudorff, *Institutional Challenges, Barriers and Opportunities: Institutional Integration* White Paper for ITMS Conference, July, 2001):

Regional Expertise

"…these numerous organizations must first agree to share information and to coordinate with one another. Subsequently, they must identify what information will be shared and how it will be utilized; define how the information will be exchanged (e.g., communications and system interfaces); determine the level and extent of their inter-agency coordination (e.g., shared control of field devices), and under what circumstances this coordination is initiated; commit the necessary resources to implement, operate, and maintain the ITMS; and develop the necessary inter-agency agreements (and possibly legislation) documenting the various ITMS agreements, policies, and procedures."

While the Concept of Operations is the starting point of the systems engineering process, and should not be looked at as *THE* place to solve institutional issues, it is clear that this document must identify key issues and begin the process of addressing them if the integration effort has any chance of success. Key institutional barriers and the strategies for surmounting them that generally must be addressed in a Concept of Operations development for a project involving regional integration are discussed below:

Barriers

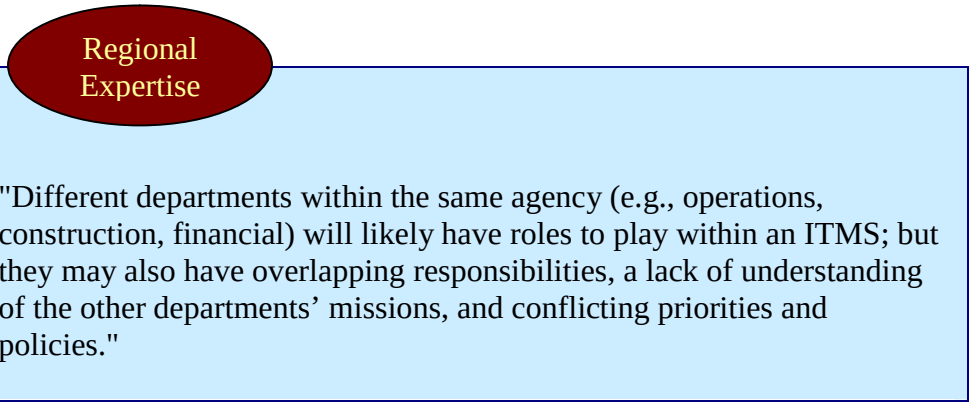
- One significant barrier identified was "institutional inertia". This refers to the lack of promptness (or willingness) of some senior managers or other transportation professionals to make the transition from a "culture" of construction and maintenance to one of operations.

Regional Expertise

"It is a relatively new way of thinking – this concept of using computers and electronics to improve traffic flow with little steel or concrete, coupled with the need to coordinate your operations with other entities – to which senior management and the institutional framework within many organizations may not have completely adjusted."

- An additional barrier is the tendency of individual agencies to exhibit tunnel vision: to focus exclusively or primarily on their own operational needs.

- In addition to the inter-agency institutional barriers described above, the paper also identified intra-agency barriers.



Strategies to Address Institutional Issues

- The best way to proactively address these concerns is by involving all classes of users in the development process as early as possible. The early inclusion of stakeholders in the Concept of Operations development process can offer the following benefits for the regional development effort:
  - It cultivates an interest in the project and underscores its importance.
  - It encourages the various participants to identify and focus on common goals, making it more likely that the conceived system will satisfy those goals.
  - It fosters each agencies appreciation of the others perspectives and institutional constraints, thereby enhancing the collaborative effort
  - It helps in the identification of any additional agencies and other stakeholders that should be participating
  - It helps in the identification of resources for Concept of Operations development and to build, operate, and maintain the proposed system.
- It is also very helpful for a lead agency (e.g., MPO, Regional TMC, state DOT) or "champion" to take the lead to organize meetings, promote the project, focus energy, and help maintain momentum.

Summarizing this guidance, please note the experience of a transportation professional who oversaw the development of the Concept of Operations for a regional traffic signal coordination project:

Regional Expertise

"We have had to deal with a host of multi-jurisdictional institutional issues to develop, implement and maintain agreement around the project concept of operations. Having strong regional champions for the project; developing structured ways to get input from all of our participating agencies; taking advantage of new funding opportunities as they have presented themselves; serving as a "neutral" third-party; taking time to build and maintain relationships with and between project stakeholders; and using opportunities to build trust in our competence to assist in traffic signal coordination have all been important to our success to date with this effort."

5.3.2 Performance Measures

As the name implies, performance measures are metrics developed to monitor and evaluate the performance of the system once it is operational. It is important for a Concept of Operations to provide the information necessary for the formulation of high-level performance measures and to describe the process for their development. This high-level definition of system performance measures should be relevant to the goals and objectives promulgated in the Concept of Operations. Performance measures are user-oriented tools for measuring system operations performance (with respect to goals) and reliability. Performance measures are also used to support future planning. Development of performance measures requires a high degree of stakeholder involvement. For the regional integration initiative this is a time-consuming and intensive process.

In the development of statewide multi-modal performance measures, Caltrans sought extensive stakeholder input, as Figure 5.2 shows. (John Wolf, California Department of Transportation (Caltrans), *Performance Measurement and Integrated Transportation Management Systems-A Traffic Operations Perspective* 4TH Integrated Transportation Management Systems (ITMS) Conference White Paper, July 15-18, 2001)

Regional Example

Caltrans Statewide Performance Measures:

Stakeholder Input

Caltrans approached the development of performance measures in a variety of ways to allow for ample stakeholder and decision maker input.

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A technical advisory group (Transportation Assessment Steering Committee or TASC) was established to assist in detailed development of system outcomes, indicators, measures, links to decision-making, data collection and terminology. The group consisted of representatives from regional transportation planning organizations, private interest groups, the Federal government and Caltrans programs and districts.

A Policy Advisory Committee (PAC) was convened to provide overall policy guidance and to review and comment on the framework as it developed. The PAC was comprised of almost fifty people representing various public and private interests in the state.

To obtain additional stakeholder perspectives, a two-day conference to specifically address transportation system performance measures was organized and presented by the University of California. Several hundred attendees from across the State representing agencies as large as the Southern California Association of Governments (SCAG) and the Bay Area Metropolitan Transportation Commission (MTC) to small, rural county governments came to Sacramento for the conference.

Government, academic and private industry representatives were gathered from across the country to discuss the topic with this wide spectrum of California transportation stakeholders. The conference helped establish a common language for developing the measures, identify critical issues and opportunities related to development and implementation of the measures, and receive input from a broad stakeholder community.

To supplement the findings from the conference, a review was also conducted of existing transportation system performance measure frameworks from other states and from California regional transportation planning organizations. The review sought to highlight the variety of approaches taken and to identify areas of consistency in approach so that California might build upon what others had already accomplished.

Public input was received from meetings held in various cities to present findings and to solicit reactions and suggestions. Formal presentations were made to several regional transportation planning organizations and to statewide transportation committees

The development group laid out the following design criteria:

- Indicators must be easy to use/simple to understand
- Indicators must be measurable across all modes
- Indicators must use existing data sources, and conform to existing performance activities (Metropolitan Transportation Commission, Southern California Association of Governments, ITMS[already developed in California] etc.) where and whenever possible

Figure 5.2 - Caltrans Statewide Performance Measures

This figure describes the process of stakeholder involvement in the development of performance measures for a statewide integrated system.

High-level performance measures should relate to specific goals for the proposed regional system. The two graphics in Figure 5.3 below demonstrate how the performance measures developed for the MAG region in Arizona (second graphic) match specific goals for the region (first graphic). (Maricopa Association of Governments, *"Regional Concepts of Final Operations: Final Report."* November 2003)

Regional Example

Maricopa Association of Governments
Regional Concept for Transportation Operations

Goals

Operational goals are prepared as a means of setting a target for the region to aim for over the next three to five year time period. Having these goals in front of all agencies provides some focused direction, leading to achieving the stated vision and mission for the region. The proposed three-year and five-year goals for the MAG Region are summarized in the following table.

Operational Categories	Three-Year Goal	Five-Year Goal
Freeway Mobility	▪ Limit the percent increase in average travel time to less than the percent increase in traffic volume.	▪ Same as three-year goal.
Arterial Mobility	▪ Limit the percent increase in average arterial travel time to less than the percent increase in traffic volume. ▪ Optimize traffic signal coordination within and between cities on major arterials, or where appropriate.	▪ Continue to limit the percent increase in average arterial travel time to less than the percent increase in traffic volume. ▪ Update the traffic signal coordination within cities and between cities every two years or when traffic volumes through the intersection change by more than five percent.
Freeway Incident Management	▪ Reduce incident duration by 10 percent.	▪ Reduce incident duration by 20 percent.
Freeway-Arterial Interface	▪ Establish integrated freeway-arterial corridor operations on one corridor.	▪ Establish integrated freeway-arterial corridor operations on three corridors.
Arterial Incident Management	▪ Conduct a feasibility and planning study for a multi-jurisdictional arterial incident management program.	▪ Implement a multi-jurisdictional arterial incident management program (based on outcomes of feasibility study).
Arterial Operations	▪ Establish a regional standard for implementation of emergency vehicle signal preemption (EVSP).	▪ Ensure adoption of the EVSP standard by each of the MAG member agencies, and implement the standard on 100 percent of the traffic signals with EVSP.
Transit Mobility	▪ Deploy a transit signal priority pilot project.	▪ Where beneficial, deploy transit signal priority to BRT routes.
Computer System Reliability	▪ Operate the system with up time of 95 percent – no more than 450 hours down time per year. Allows for approximately eight hours of system maintenance per week. Maintenance is preferably conducted in off-peak periods. ▪ Minimize system down time to an average of one hour per system failure.	▪ The five-year goals for system reliability are the same as the three-year goals.

Operational Categories	Three-Year Goal	Five-Year Goal
Multi-Agency Coordination	▪ Establish center-to-center communications between 15 agencies in the region. These agencies should include traffic and transportation, enforcement, emergency management, and transit. ▪ Facilitate incident and emergency response and travel information sharing between 15 agencies.	▪ Establish center-to-center communications between 20 agencies in the region. These agencies should include traffic and transportation, enforcement, emergency services, and transit. ▪ Facilitate incident and emergency response and travel information sharing between 20 agencies.
Travel Information Provision	▪ Increase travel information usage (web, 511, television, radio, etc.) by 100 percent, and achieve a 75 percent customer satisfaction rating. On a scale of 1 to 10, a score of 7 or higher is desired. ▪ Expand Phase 1 of the ADOT / MCDOT / City of Scottsdale web-based HCRS pilot project for local closure and restriction information to include 5 additional MAG member agencies (Phase 2). ▪ Incorporate transit status information from AVL data from buses into travel information services. ▪ Develop web-based arterial maps for 100% of instrumented smart corridors.	▪ Increase travel information usage (web, 511, television, radio, etc.) by 200 percent, and achieve a 75 percent customer satisfaction rating. On a scale of 1 to 10, a score of 7 or higher is desired. ▪ Evaluate performance capabilities of Phase 2 web based HCRS pilot project for local closure and restriction information and expand to include additional MAG member agencies. ▪ Obtain travel time information on 50% of instrumented arterial roadways and post this information to Web, 511, and variable message signs.

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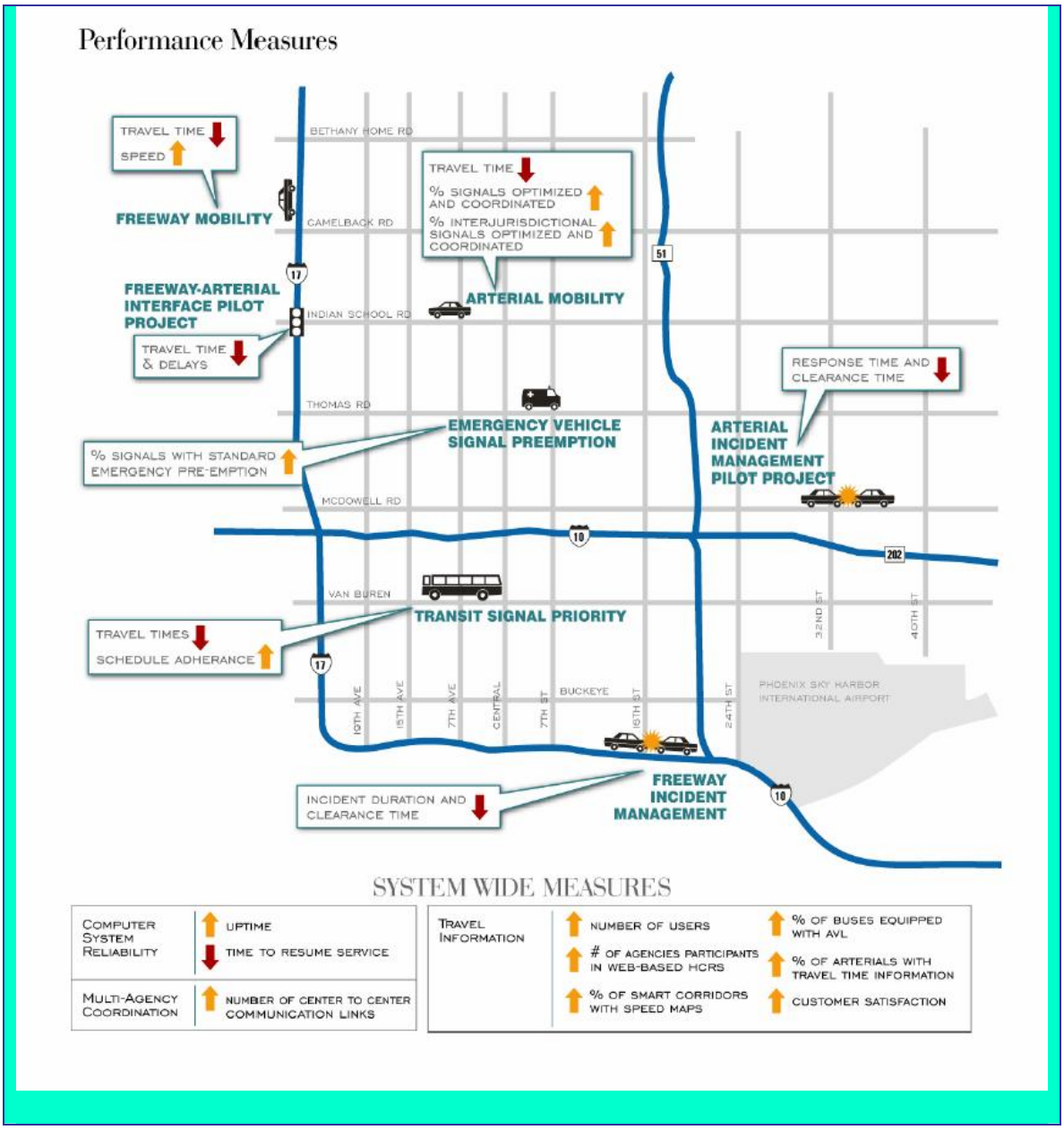


Figure 5.3 - Maricopa Association of Governments Regional Concept for Transportation Operations

These two graphics demonstrate how the performance measures developed for the MAG region in Arizona (second graphic) match specific goals for the region (first graphic).

5.4 DEVELOPING THE ELEMENTS

Scope

Set Boundaries on the Scope of the System

This should be considered tentative at the beginning of the process, but once the relevant Concept of Operations development phases are completed the boundaries' description can be solidified. It must be remembered that, especially with an integration project, the boundaries can be functional, political and institutional as well as spatial and temporal.

There is a great temptation, especially when the collective energy of the regional stakeholders has been fully engaged, to try to establish a "super system", with a multitude of capabilities and interconnects. The practice of "over-scoping" the regional project beyond that which is manageable should be discouraged; every phase of the systems engineering process could be overburdened and the energy and commitment of stakeholders could wane, leading to "stakeholder turnover".

One of the transportation professionals involved in regional integration, whom we interviewed for the development of this guide, had this to say on the subject of scope:

Regional Expertise

"If had it to do over, we would have identified fewer goals, making everything more manageable and practicable – doable within our time frame. We are not moving along at the pace we expected."

Purpose for Implementation of the proposed System, Major Objectives and Goals, and Vision

Although generally stated, these subsections all require major stakeholder consideration, participation and input, especially given the magnitude of the proposed system. For this reason, we stress the importance of careful identification of users and stakeholders; please see the discussion above on Stakeholder Identification and Involvement.

Referenced Documents

It is important to list the resource documents that support the Concept of Operations development; they serve as the basis for understanding the rationale for the proposed system and they provide interested parties with a guide fro finding more information. There are likely to be many documents supporting the regional initiative. Types of reference sources that are typically listed include:

- The Concepts of Operations and Functional Requirements of all constituent systems as well as those impacted by the regional project should be included. This is important for understanding and demonstrating need, identifying stakeholders, and establishing interconnects and information flows.

- Regional *Business Planning Documents* are useful for stakeholder identification and to support decision-making related to phasing the project.

- *Human Resources*: Identifying experts in various aspects of systems operations - whether fiscal, human, or technological – as well as local "champions" may be helpful for developers of this or other regional systems.

- Regional *Studies* of operational needs can be used to support needs-assessment and justification for the proposed system.

- System Development *Meeting Minutes* can provide useful information for future system integration efforts or for future refinement of the currently proposed system.

- *Strategic Plans* and *Strategic Plan Updates*, including *Regional ITS Architecture* and any *Regional Transportation Concept of Transportation Operations (RCTO)* should be referenced as a starting point for Concept of Operations development as they provide the context for identifying institutional issues and for defining goals and responsibilities.

User-Oriented Operational Description

Strategies for accomplishing goals and objectives for the proposed operation of a regional system must be described from each user's orientation within the regional context. The system overview must describe the user's roles and responsibilities – including shared responsibilities - and the order in which operations take place. All interactions between systems and subsystems within the scope of the project must be elucidated. There are likely to be more constraints on a cross-jurisdictional system and they must be clearly addressed. All policies and procedures necessary to support regional integration must be described.

As the companion document pointed out, the User Orientated Operational Descriptions are sometimes contained only in the scenarios. For clarity and thoroughness in describing a regional system, it is a better practice to provide this information *both* in this section and in the scenarios.

Operational Needs

This subsection addresses the question of what is required by the region that the current system or set of services does not provide. This implies a description of the process for identifying these requirements and for establishing their relationship to the current operational environment.

It might be beneficial to approach the question as the Maricopa Association Governments did in developing their RCTO:

Regional Expertise

"… it was important to identify what 'functions' local agencies had to consider with the region in mind – such as coordinating traffic signals on cross-jurisdictional corridors – and what 'functions' were indeed regional in nature, such as freeway operations or travel information".

It is important to establish the context and methodology for assessing needs.

The Operational Needs section is the place to make the case for the proposed regional system and it is important to: 1) be sure that the needs statement satisfies all of the user and stakeholder expectations, and 2) align the needs with the proposed remedies. Be sure that the stated need and the proposed modified operations or added capabilities match. This is especially important for a regional initiative because of the number and diversity of people who will be needed to support the system and who will need to "buy" into it. In order to surmount institutional barriers to sensitive issues such as shared control, funding, and enabling agreements, justification for the proposed operations must be clearly stated and well-documented.

System Overview

The System Overview is intended to describe all aspects of the system at once. This includes the system scope, users, system interfaces, system states and modes, system capabilities, system goals and objectives, and system architecture, all at a high-level. The use of diagrams is highly recommended because diagrams concisely communicate a large amount of information for a complex system. This can be a problem when describing large and complex integrated systems, as the diagram can become too cluttered to serve its purpose. In this case, it might be best then to use a series of diagrams that starts with a high-level view of the integrated system and then breaks out geographical/jurisdictional zones or identified functionalities for emphasis or for more detail.

In Figure 5.4, the Concept of Operations for the VII Michigan Test Bed Program provides a series of maps depicting the same system overview, but then using fading (or transparency increase) to deemphasize/emphasize user roles and responsibilities among the public and private sector:

Regional Example

VII Michigan Test Bed Program

Concept of Operations

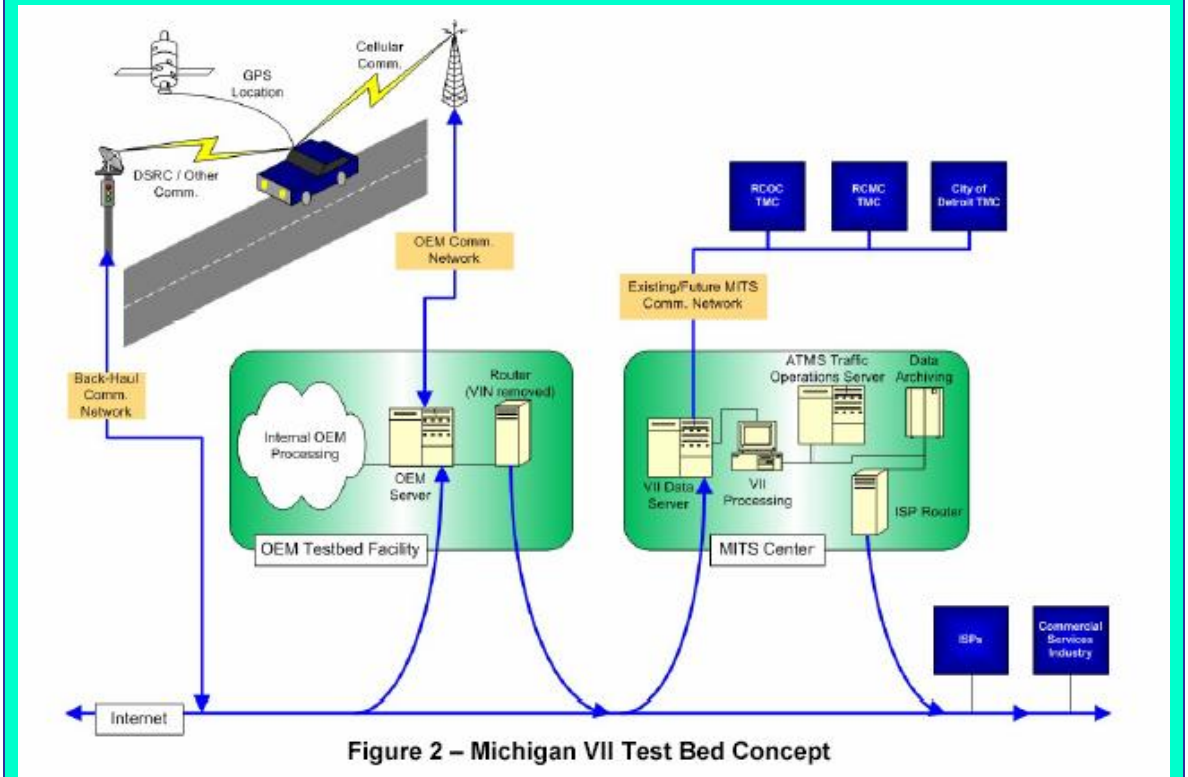


Figure 2 – Michigan VII Test Bed Concept

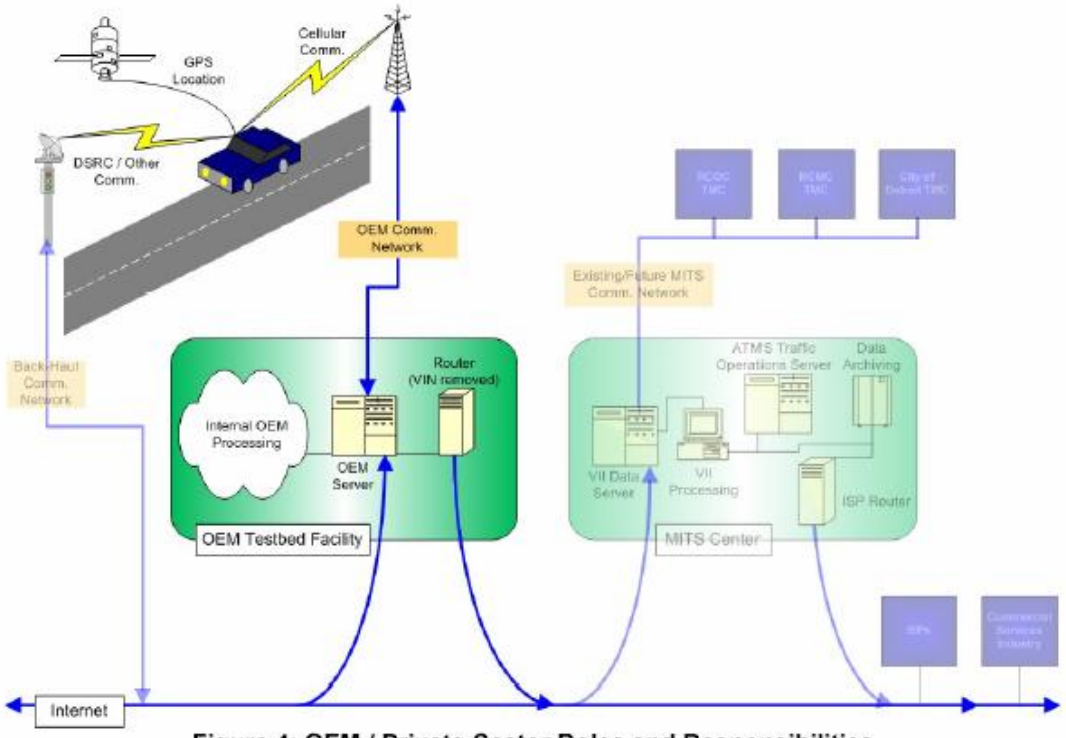


Figure 4: OEM / Private-Sector Roles and Responsibilities

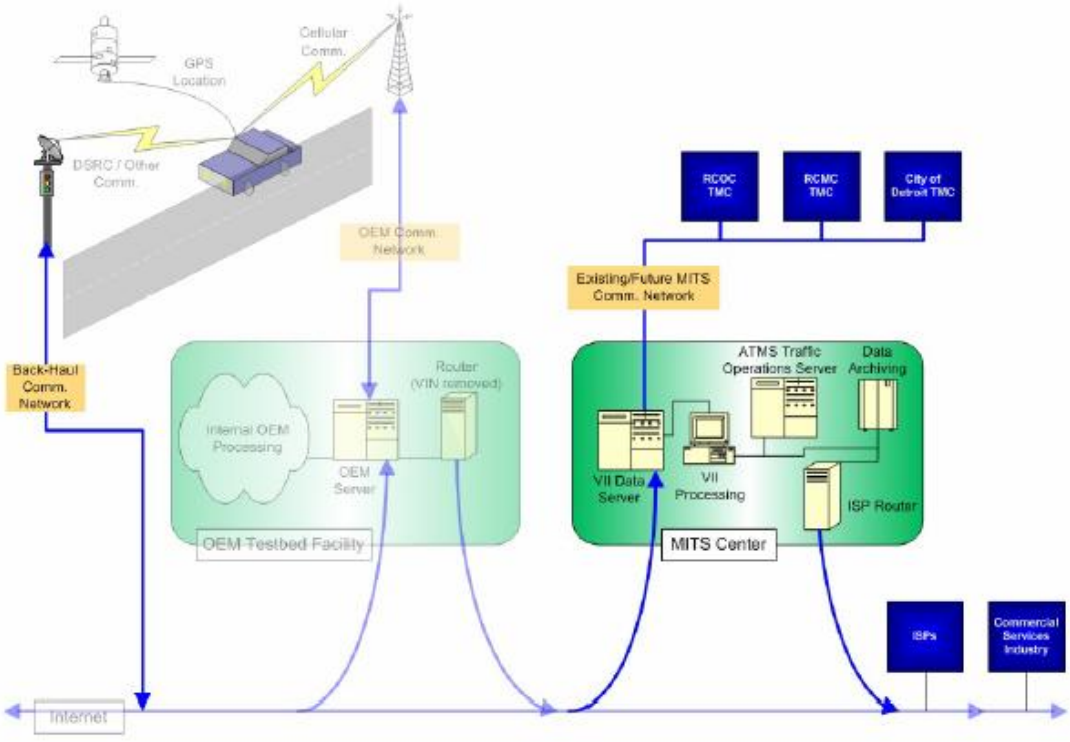


Figure 5: MDOT / Public-Sector Roles and Responsibilities

Figure 5.4 - VII Michigan Test Bed Program Concept of Operations

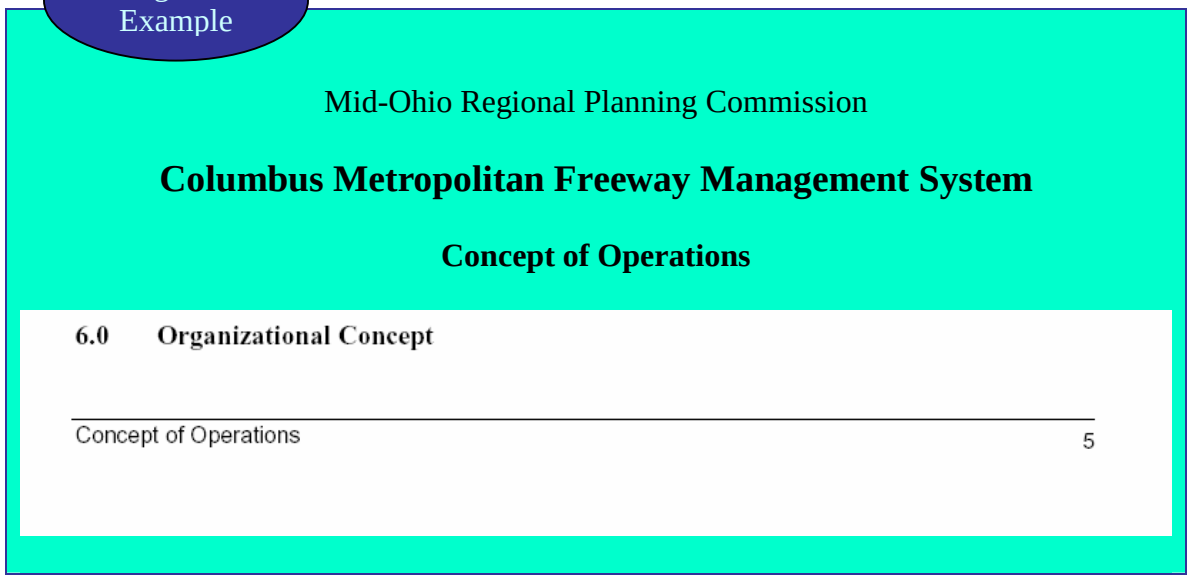
This figure shows a series of maps depicting the system overview and the roles and responsibilities of public and private sector users.

Operational and Support Environments

The ANSI/AIAA standard describes this section thusly: "This section should describe the required physical operational environment, if known, in terms of facilities, equipment, computing hardware, software, personnel, operational procedures and support necessary to operate the deployed system." Depending on the nature of the regional initiative, it is possible that much of the physical operational environment will be known; much of the infrastructure for the proposed integration, and the procedures and personnel needed to operate and maintain it, may already be in place. Even so, the added functionality and other factors that the regional integration demands will need to be clearly documented.

Figure 5.5 shows Section 6 of the Columbus Metropolitan Freeway Management System Concept of Operations, which details the personnel, operational procedures and support necessary to operate the deployed system (Mid-Ohio Regional Planning Commission, Columbus Metropolitan Freeway Management System *Detailed Project Plan: Concept of Operations* prepared by DMJM+Harris, Inc., March 2001)

Regional Example



The organizational concept addresses agency roles and responsibilities; staffing; hours of operation; and dispute resolution.

Agency Roles and Responsibilities

ODOT will own, operate and maintain the CMFMS. The division of responsibilities between ODOT and the City's Division of Parking and Traffic is shown below in Exhibit 1.

Exhibit 1 – Agency Responsibilities

System	Agency
CMFMS Operations	ODOT / City
CMFMS Maintenance	ODOT
ATIS	ODOT / City
Computer Controlled Signal System	City
Ramp Metering	ODOT / City
Incident Management	ODOT / City Police & Fire / City Traffic (TERT)

The cost of installing, operating, maintaining, upgrading or replacing the equipment located along the arterials and freeways will be the responsibility of the respective operating parties as indicated above, and all expenditures will be at the agency's complete discretion.

The CMFMS Supervisor, with input from the City, will develop Standard Operating Guidelines that will provide the day-to-day roles, responsibilities, and communications requirements for operations and maintenance staff assigned to the CMFMS. These Standard Operating Guidelines will include but not be limited to the following:

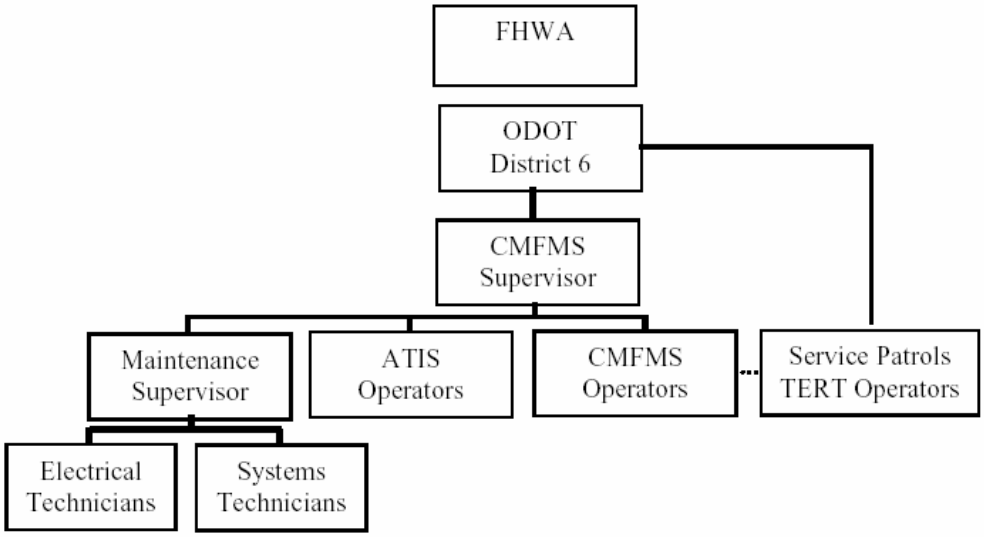
- Identifying personnel from ODOT and the City who have operational access to CMFMS;
- Clearly delineating the roles of personnel working with the CMFMS;
- Clearly stating which agency has exclusive or primary responsibility for certain actions necessary for transportation and emergency operations and management, and where supporting roles are planned (i.e., operation of the other agency's equipment when they are not present);

- Establishing detailed guidelines for personnel to manage or respond to incidents and events as they occur; and

- Clearly delineating the roles, responsibilities, and access of other CORTRAN partners sharing in the operation of the CMFMS.

The organizational structure for the CMFMS is presented Exhibit 2. This structure was developed to foster integration among ODOT / City operations staff while minimizing redundancy in the day-to-day operations of their agencies' functions.

Exhibit 2 – CMFMS Organization Chart



Staffing Plan

A brief description of the roles and responsibilities of key staff positions, to support the organizational concept, is presented below:

CMFMS Supervisor - The CMFMS Supervisor provides "hands-on" management of the day-to-day operations for the CMFMS. Specifically, the CMFMS Supervisor is responsible for managing and scheduling the operations staff; providing training of the operators; assisting operators during periods of high activity or staff shortages; assigning staff authorization to control subsystems; assisting in identifying problems and determining times for preventive / corrective maintenance; and developing procedures dealing with planned and unplanned events. Reports to the ODOT District 6 Office.

CMFMS Operator - CMFMS Operators monitor and control the CMFMS field devices from the CORTRAN facility. Specifically, this position is responsible for operation of CCTVs, DMSs, ramp meters, lane control signals, HAR; and other assignments made by the CMFMS Supervisor. Operators are also responsible for responding to public inquiries regarding traffic condition and notifying appropriate agencies when an incident occurs. Reports to the CMFMS Supervisor.

ATIS Operator - ATIS Operators distribute traveler information through the HAR, website and other means (e.g., 511 system). They evaluate and package data into useful, timely and accurate traveler information. Reports to the CMFMS Supervisor.

Maintenance Supervisor – The Maintenance Supervisor is responsible for maintenance of the CMFMS. This position troubleshoots both control center and field equipment and works directly with the ODOT District 6 Maintenance Department to coordinate the maintenance crews to repair electronic equipment used in traffic control devices, CCTV systems, and the fiber optic communications plant. This position is also responsible for documentation of changes made to any component in the system through maintenance or construction operations. This position reports directly to the CMFMS Supervisor.

Electrical Technician – The Electronic Technician is responsible for troubleshooting and repairing electronic equipment used in traffic control devices, CCTV systems, and the fiber optic communications plant. This position is also responsible for documentation of changes made to any component in the system through maintenance or construction operations. This position reports directly to the Maintenance Supervisor.

Systems Technician – The Systems Technician is responsible for maintaining current and / or consistent computer operating systems on all computer equipment; installing hardware and software upgrades; troubleshooting and repairing equipment malfunctions; maintaining computer communication links with CORTRAN partners; and maintaining database and data files for all CMFMS activity. Reports to the Maintenance Supervisor.

In addition, the CMFMS Operators will coordinate with the local District 6's Service Patrols and TERT Operators within the region.

Hours of Operation

The CMFMS will initially operate Monday – Friday, 6 am to 8 pm as well as during special events (e.g., OSU football games, Red, White & Boom, etc.). This coverage will ultimately expand to 24 hours / day, 7 days / week. The CMFMS will be used remotely by CMFMS Operators to be assigned off-duty responsibilities on a rotational basis.

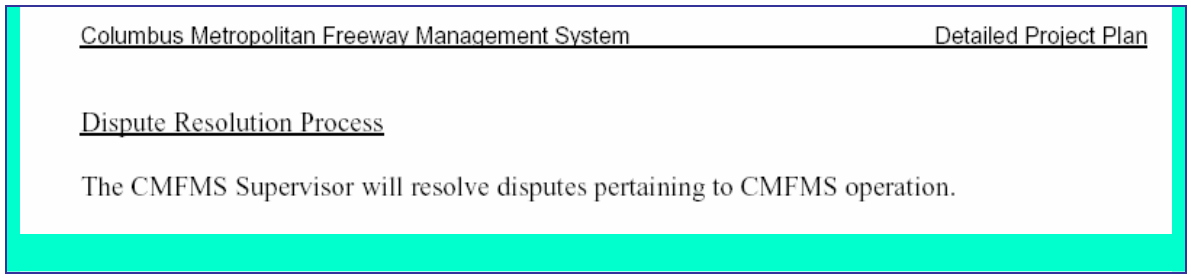


Figure 5.5 - Columbus Metropolitan Freeway Management System Concept of Operations

This figure shows Section 6 Organizational Structure, which details the personnel, operational procedures and support necessary to operate the deployed regional system.

The companion document, which focused on single agency or local TMC development, warned against neglecting the *institutional environment*. If this injunction is important for the local TMC Concept of Operations, it is *critical* for the regional document. The cross-jurisdictional nature of the regional institutional environment requires that roles and responsibilities be clearly delineated and that necessary agreements be identified.

Operational Scenarios

Scenarios represent the single most important segment of the Concept of Operations. For a regional integration effort, they provide a great opportunity for demonstrating how the completed system should work for all users in the region, under every foreseeable condition for which the system is designed, including extreme event conditions. The complexities and intricacies of the integration, which have been presented in static form thus far, can now be further described and clarified through dynamic examples of how they will operate in a real world circumstance.

As a start, the writing team could ask all regional stakeholders to provide a synopsis of how and under what conditions they expect to use the system. Writers can then tap their own experience and expertise in using this information to generate a hypothetical scenario. Any scenarios that exist in documents from the constituent systems should also be reviewed (and perhaps eventually updated to reflect the new regional functionality).

It is reasonable to assume that a Concept of Operations for a regional initiative will require a greater number of scenarios than that for a single TMC. The number of scenarios required will depend upon the spatial, temporal, and functional aspects of the project, the political and institutional boundaries, the number and variety of users, and the expected conditions for operation.

The Concept of Operations for the I-95 Corridor Coalition Information Systems Network (Figure 5.6) provides eleven operational scenarios that describe various functions performed under conditions ranging from normal to "stressed" or "extreme". (I-95 Corridor Coalition, *Information Systems Network: Concept of Operations*, September 2005)

Regional Example

I-95 Corridor Coalition

Information Systems Network

Concept of Operations

5 OPERATIONAL SCENARIOS

A scenario is a step-by-step description of how the proposed system should operate and interact with its users and its external interfaces under a given set of circumstances. The following scenarios will allow readers to walk through activities and gain an understanding of how the various parts of the proposed system function and interact. The scenarios will tie together the system, the users, and other entities by describing how they interact.

In scenarios where it is necessary for a [Primary TMC] to consult with a [Secondary TMC], ISN users should reference contact information provided in the ISN.

5.1 Subscribing to the Information Systems Network

A key component of the ISN will be the registry of information subscribers and providers within the network. Subscribing agencies (system stakeholders) will use this registry to discover information on the ISN and to contact those agencies providing the information.

When an [Agency] determines that it wants to get information from a neighboring system the [Agency] submits their credentials to the ISN administrator. The ISN administrative oversight group clears the [Agency] for subscription to the ISN. The ISN administrator registers the [Agency] to the ISN.

5.2 Publishing to the Information Systems Network

As discussed in the previous scenario, a key component of the ISN will be the registry of information subscribers and providers within the network. Information providers will publish information to the locations and in the formats specified in the registry.

When an [Agency] determines that it wants to publish information to the ISN the [Agency] must assure that the [System] providing information to the ISN complies with ISN standards for publication. The [Agency] will submit its credentials to the ISN administrator. ISN administrative oversight group clears the [Agency] for publishing to ISN and the ISN administrator registers the [System] in ISN.

5.3 Operation without Incidents

TMCs monitor traffic conditions through various sources, including: the ISN, CCTV, speed sensors, and other intelligent transportation systems. When TMC operators discover incidents, they assess the situation and provide information to other agencies and the traveling public. If a TMC does not encounter any unusual situations, no information is published to the ISN, DMS, HAR, or 511 systems. Websites show traffic moving at normal speeds.

5.4 Highway Incident

In some situations, an incident that affects the primary TMC may not have an impact on a secondary TMC. In this scenario, a multi-vehicle crash occurs on a

major highway. [TMC1] detects slow moving traffic as a result of the crash. [TMC1] operators assess the situation and determine the effects are serious enough to publish information to the ISN, DMS, HAR, and 511.

[TMC2] discovers information about the multi-vehicle crash and its effects on traffic. [TMC2] determines that the event will not affect its region of operations and takes no action. [TMC1] will continuously publish updates about the incident to the ISN, therefore [TMC2] will monitor updates to determine if action should be taken at a later point in time.

When the incident is cleared, [TMC1] publishes the update to the ISN and closes the event. [TMC2] receives the update, since no actions were taken in response to the incident, no actions are taken in response to its cancellation.

5.5 *Exceptional Congestion*

A transit system outage occurs, forcing commuters to use other modes of transportation. A large portion of these travelers will choose to travel in private vehicles. The potential of an increased number of private vehicles on the roadways threatens to significantly impact highway traffic conditions. Realizing the severity of the situation, [TransitMC] publishes information about the outage on their website, the ISN, and notifies the media.

As [TMC3] is monitoring traffic events, operators discover information about the transit outage on the ISN. [TMC3] assesses the situation and determines that the transit outage may significantly increase congestion in its region of operations. [TMC3] publishes information about the outage to DMS, HAR, 511, and other traveler information systems in their area.

Until the outage is resolved, [TransitMC] continuously publishes updates to the ISN. When [TransitMC] recovers from the outage, they publish an update to the ISN and close the event. [TMC3] receives the update, removes messages from traveler information systems, and closes the event.

5.6 *Work Zone*

Pre-planned work or events should be (although are not always) coordinated with neighboring agencies prior to publishing information to the ISN. This scenario is an example of a work zone event that was not coordinated with neighboring agencies prior to publishing the event to the ISN.

[TMC4] has planned a work zone for a segment of highway in their region of operations. [TMC4] works to establish an operating plan to provide alternate routes and traveler information during the period of abnormal operations. [TMC4] does not expect the work zone event to affect operations in the [TMC5] region and therefore does not notify them prior to publishing the event to the ISN.

[TMC5] discovers the upcoming event information on the ISN and determines that the event will affect patterns in its region of operation. [TMC5] consults with [TMC4] to prepare traveler information for alternate routes and publishes the information to DMS and HAR during work zone operations.

[TMC4] publishes any changes in work zone operations to the ISN. [TMC5] updates traveler information systems as needed. When work zone operations are complete, [TMC4] publishes an update and closes work zone messages. [TMC5] receives the update and closes messages they have initiated. Normal operations have resumed.

5.7 *Winter Weather*

A winter weather advisory indicates that a nor'easter is due to pass through the eastern seaboard. Agencies in adjoining jurisdictions will be affected differently, with snowfalls varying drastically in a single jurisdiction and from one jurisdiction to another. If the storm moves quickly, cold rain or snow may fall for six to eight hours. If the warm air stalls against a high pressure wall, the snowfall may last 24 hours or more, as it has done in the past. Roadways, transit transportation services, businesses, and possibly entire cities or states may close as a result of the storm conditions. Agencies are limited to the amount of information available for publishing prior to the onset of the storm. However, they will work together prior to the storm to provide traveler guidance before entering regions with potentially dangerous road conditions.

Multiple agencies will publish information about road and weather conditions to the ISN during the storm. For this scenario, multiple agencies are referred to as "[TMCs]" and a single agency is referred to as "[TMC7]".

The nor'easter sets in, and as expected, snowfall amounts range drastically throughout the eastern seaboard. [TMCs] publish a variety of winter road operation messages to DMS and HAR in their respective region and to the ISN. 511 systems throughout the eastern seaboard get event information from the ISN and formulate and publish broadcast messages to their region of operations. The following are examples of messages that may be published to the ISN:

- Philadelphia: "I-95 – Icy road conditions"
- Philadelphia: "I-476 – 4 feet of snow"
- New York City: "Staten Island – 70 mph winds, blizzard conditions, low visibility"
- Connecticut: "I-95 closed from Greenwich to New Haven, use alternate route"

[TMC7] determines that operations in two [TMCs] may affect traffic patterns in its region of operations. [TMC7] disregards information that does not affect its region of operations and locates contact information for appropriate [TMCs], which may be found in the ISN Contact Database. [TMC7] works with the two [TMCs] individually to prepare traveler information on alternate routes between their regions of operation. [TMC7] publishes information to DMS and HAR regarding winter conditions and alternate routes for travelers entering the neighboring region.

Surrounding [TMCs] continuously publish updates to road weather conditions. As storm conditions subside and winter operations cease, the [TMCs] publish updates and close winter operation messages. 511 systems receive updates and remove

messages from traveler information services. [TMC7] receives the updates and removes messages for the respective region.

5.8 *HAZMAT Closure*

A multi-vehicle crash occurs on a major highway, resulting in an emergency operating mode requiring extensive emergency response operations. An overturned tractor trailer leaking diesel fuel and hydraulic oil has blocked traffic and caused congestion to build up around the incident. Emergency services personnel, at the scene of the crash, discover the hazardous material spills, close the highway, and request HAZMAT response.

[TMC8] detects the incident remotely, surveys the scene, and publishes event information to DMS and HAR in their jurisdiction. Event information is picked up by the 511 system and the ISN. [TMC9] discovers event information on the ISN and determines that operations in [TMC8] region will affect traffic patterns in its region of operations. [TMC9] consults with [TMC8] to prepare traveler information for alternate routes. [TMC9] publishes information to DMS and HAR on [TMC8] closure and alternate routes. Meanwhile, HAZMAT works diligently at the scene of the spill to prevent any material from entering the stormdrain system and any subsequent natural waterways.

[TMC8] continues to monitor the event and publish updates to ISN. [TMC9] evaluates updates to determine if any changes need to be made to traffic patterns. The incident is cleared and HAZMAT assures that the hazardous material spills are fully remedied. [TMC8] publishes an update and closes event. [TMC9] discovers the update, removes closure and alternate route messages.

5.9 *Weather Closure*

This scenario builds on the "Winter Weather" scenario, moving from an abnormal mode to an emergency mode.

A nor'easter has swept through an agency's region of operations. Snowdrifts have blocked segments of major highways. The major portion of the region monitored by [TMC10] has been officially closed down by order of the Governor. Surrounding regions use information from the ISN to inform travelers of alternate routes prior to reaching a segment of closed highway.

[TMC10] publishes notice of closed roadways on DMS and HAR. Road closures are picked up on 511 systems and the ISN. [TMC11] discovers event information on the ISN and determines that operations in [TMC10] region will affect traffic patterns in its region of operations. [TMC11] consults with [TMC10] to prepare traveler information for alternate routes. [TMC11] publishes event information to DMS and HAR on [TMC10] winter conditions and alternate routes. [TMC10] continuously publishes updates to the ISN and [TMC11] evaluates updates to determine the impact on its region of operations.

After several hours, winter weather conditions subside and maintenance crews clear roadways. As roadways are cleared and reopened, [TMC10] publishes updates and closes winter weather messages. 511 systems and [TMC11] receive updates and remove winter weather messages.

5.10 Hurricane Evacuation

Officials issue a mandatory hurricane evacuation and implement lane reversal plans. Transportation operations are affected across multiple regions and responding agencies. [TMC12] publishes notification of evacuation routes and lane reversals on DMS and HAR. Event information is picked up on 511 systems and the ISN. [TMC13] discovers event information on the ISN and determines that operations in [TMC12] region may affect traffic patterns in its region of operations. [TMC13] consults with [TMC12] to prepare traveler information on alternate routes.

If necessary, [TMC13] may initiate lane reversals on select roadways to support traffic patterns and allow for maximum outbound use. [TMC13] publishes event information to DMS and HAR on [TMC12] hurricane conditions and alternate routes. [TMC12] continuously publishes updates to ISN and [TMC13] monitors updates to determine if changes should be made to traffic operations.

Hurricane conditions clear and maintenance personnel from stakeholder agencies clear debris and begin repairing damaged roadways. As roadways are reopened, [TMC12] publishes updates and closes hurricane evacuation messages. [TMC13] and 511 service receive updates and remove hurricane evacuation messages.

5.11 Terrorist Act

This scenario describes the response to a terrorist act requiring TMCs to function in disaster operating mode with extensive emergency response operations. Terrorists rammed a barge carrying flammable materials into a major bridge causing severe damage and rendering the bridge impassible. Traffic and waterway operations experience considerably degraded operations.

Emergency Services stakeholders and operators close the bridge and highway approaches. [TMC14] publishes notice of the closed bridge on DMS and HAR. Event information is picked up on the ISN and 511 system. USCG Captain discovers event information on the ISN and closes down the waterway. USCG Captain works with neighboring agencies to redirect watercraft to surrounding ports.

[TMC15] discovers event information on ISN and determines that traffic operations in [TMC14] region may affect traffic operations in its region. [TMC15] consults with [TMC14] to prepare traveler information on alternate routes. [TMC15] publishes traveler information to DMS and HAR regarding [TMC14] bridge closure and alternate routes. [TMC14] continuously publishes any changes in events to the ISN. [TMC15] monitors updates for changes or notice that the events have cleared.

The waterway is reopened to watercraft during reconstruction of the bridge. When construction is complete, the bridge is reopened and normal traffic operations resume. [TMC14] publishes an update and closes messages. 511 service and [TMC15] receive the update and remove messages.

Figure 5.6 - I-95 Corridor Coalition, Information Systems Network: Concept of Operations

This figure depicts section 5 of the Concept of Operations which presents eleven operational scenarios that describe various functions performed under conditions ranging from normal to "stressed" or "extreme".

5.5 CHAPTER SUMMARY

This chapter addressed critical issues involved in developing a Concept of Operations for a regional integration initiative. It used advice from regional experts and best practices contained in regional examples to advance strategies for developing the document. This chapter spoke to the formative issues of assembling the writing team and gathering necessary resources. It described how to involve stakeholders in the tasks of confronting institutional barriers and developing performance measures. The chapter also addressed issues involved in developing the core elements.

5.6 SPECIFIC LITERATURE SUPPORTING THIS CHAPTER:

- USDOT ITS, Next Generation 9-1-1 System Preliminary Concept of Operations

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- Maricopa Association of Governments, “Regional Concepts of Final Operations: Final Report.” November 2003

http://www.mag.maricopa.gov/pdf/cms.resource/RCTO-Final_Report79101.pdf

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